

The use of the pheromone mating disruption method against fruit moths in private allotments

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Abstract: The availability of pesticides in private gardens is limited by local laws in the State of Baden-Württemberg (Germany). Only 26 insecticides, fungicides and molluscicides are permitted. Hence, only pesticides such as *Bacillus thuringiensis*, granulosis virus, pyrethrum or mating disruption by pheromone (MD) are permitted for moth control in apple, plum and other fruit trees. Beneficials like *Trichogramma* sp. or *Chrysoperla carnea* can also be used. MD had previously not been investigated in allotments. In the experiments carried out in 1998 and 1999, MD was compared with the use of the egg parasites, *Trichogramma dendrolimi* and *Trichogramma cacoeciae*. The observations were done in 102 allotments, each of about 300 m². In 1997, attacks of codling moth were generally low throughout southern Germany. This was reflected in the allotments where there was less than 1% fruit damage with treatment by MD or egg parasites the following year. During 1999, the attacks were generally much higher, resulting in a higher use of insecticides in commercial German orchards. In the allotments, about 6 to 8% of fruits were damaged by codling moth in both experimental treatments. The results indicate that MD can be successful in allotments, and is equally effective as the use of egg-parasites. However, further experiments are required.

Keywords: private gardens, allotments, *Cydia pomonella*, codling moth, *Adoxophyes orana*, summerfruit tortrix moth, *Grapholitha funebrana*, plum fruit moth, pheromone, mating disruption technique, biological control, *Trichogramma dendrolimi*, *Trichogramma cacoeciae*.

Introduction

Allotments are important for recreation, especially for people who live in densely populated areas of south-west Germany. The availability of pesticides in these private gardens is limited by the law (GBI, p. 426: "Gesetz über die Einschränkung der Anwendung von Pflanzenschutzmitteln"; State of Baden-Württemberg, 17 December 1990). Hence, only pesticides such as *Bacillus thuringiensis*, granulosis virus, pyrethrum or pheromone mating disruption method (MD) are permitted for moth control in apples, plums and other fruit trees.

MD in orchards is widely used in some areas of southern Europe (Waldner 1996, 1997), South Africa (Barnes & Blomefield 1997) and North America (Thomson 1997) and is progress-

ing from the experimental phase into commercial practice in Baden-Württemberg (Galli 1998). However, MD is a completely new method for private gardens.

In the two years of experiments, MD was compared with the use of the egg parasites, *Trichogramma dendrolimi* and *Trichogramma cacoeciae* to see if these methods would work in allotment gardens ("Kleingarten, Schrebergarten"), and which should be used in the future.

Material and methods

In the first year, pest species and beneficials were monitored by pheromone traps and the direct observation of damage. In the second year, the whole allotment area was divided into three sections for (1) application of MD, (2) application of granulosis virus and (3) use of the beneficials *Trichogramma dendrolimi* and *T. cacoeciae*. In the third year, the experiments were repeated, but MD was used in the granulosis virus plot. In each section, 1 to 3 pheromone traps were installed for each moth species. Traps for codling moth, *Cydia pomonella*, and summerfruit tortrix, *Adoxophyes orana*, were installed on 4 May 1998 and for plum fruit moth *Grapholitha funebrana*, on 8 May. All traps were inspected weekly from 11 May to 28 of September. In 1999, the *Cydia pomonella* and *Grapholitha funebrana* traps were installed from 16 April to 6 May, and the *Adoxophyes orana* traps from 10-14 May. Inspections were done weekly up to 17 September.

The observations were done in 102 allotments which suffered from codling moth and plum fruit moth. Allotments were each about 300 m², comprising about 4.5 ha. About one third of the allotments area is used for vegetable-production, one third for fruit culture (mostly apple, but also plum, peach, pear, yellow plum and apricot) and one third for ornamentals and lawn. Thus on an area of 4.5 ha there is dispersed fruit culture on only about one hectare.

Section treatments were as follows: (1) Granulosis virus: 0.3 to 0.5 l/ha (only once). (2) *Trichogramma*: altogether 1260 cards (1998) and 1240 cards (1999). In plum, there were six applications from 20 May to 10 August, in 1998 and in 1999, there were also six applications from 12 May to 12 August. In apple, there were five applications from 20 May to 10 August (1998) and 12 August (1999). (3) MD: 12 dispensers (codling moth and summer fruit tortrix moth (RAK 3+4) and 15 dispensers (plum fruit moth (RAK 5) per garden and 297 in the surroundings of the allotment area. In all, 1512 dispensers (applied on 11 May) were used in 1998 and 1917 dispensers (applied on 17 May) in 1999.

Results

In 1997, attacks of codling moth were generally low throughout the southern Germany. This was also the situation in the allotment gardens (Table 1). This low attack rate was reflected in the catches of the pheromone traps in 1998. In the Rosenweg and Mondscheinweg, where granulosis virus and *Trichogramma* had been used, the catches were relatively low with 1.39 and 2.93 moths per trap per week (Table 2). However, where MD was used in the single gardens and the Gulaschgasse, codling moth trap captures were between 0.08 and 0.31 males per trap per week. On the other hand, the attack of the plum fruit moth in 1997 was high (100% plum attack). The 1998 trap catches of this species were subsequently high with up to 24.28 moths per trap per week.

Table 1. Estimation of moth infestation in apple and plum in the allotment gardens (Tapach, 1997).

Date	<i>C. pomonella</i>	<i>G. funebrana</i>
14 July 1997	1%	100%
8 September 1997	4%	-

Table 2. Mean number of moths per pheromone trap per week, 1998

Section	Method	<i>C. pomonella</i>	<i>A. orana</i>	<i>G. funebrana</i>
Single gardens	MD	0.31	1.0	0.67
Gulaschgasse	MD	0.08	0.0	0.81
Rosenweg	<i>Trichogramma</i>	1.39	2.0	4.0
Mondscheinweg	granulosis virus (once) and <i>Trichogramma</i>	2.93	5.2	24.28

These very low codling moth catches are in line with very low fruit damage. In summer and autumn 1998 there was less than one per cent fruit damage on apples by MD and the egg parasites in the allotments (Table 2). The other two moth species (*A. orana* and fruitlet mining tortrix, *Pammene rhediella*) were unimportant in the gardens. The high catches of the plum fruit moth in the pheromone traps corresponded to a relatively high infestation of the plums (Table 4), but this is low compared with the attack in 1997.

Table 3. Estimation of moth infestation on apple in the allotment gardens (Tapach, September 1998).

Section	Method	<i>C. pomonella</i>	<i>A. orana</i>	<i>P. rhediella</i>
Single gardens	MD	0.9	0.05	0.1
Gulaschgasse	MD	0.76	0.06	0.06
Rosenweg	<i>Trichogramma</i>	0.55	0.06	0.06
Mondscheinweg	granulosis virus (once) and <i>Trichogramma</i>	0.58	0.08	0.08
Mondschein-weg	untreated	4.0		

During 1999, the catches of the pheromone traps were much higher in the area where the beneficials were used than in 1998, whereas in the MD area, the catches were low (Table 5). This was reflected by apple infestation. In the allotments, more than 6% of fruits were damaged by the moths in both experimental treatments (Table 6). In that year, the attacks of the fruit moths were generally much higher, resulting in a higher use of insecticides in commercial orchards in South-western Germany.

Table 4. Estimation of moth infestation on plum in the allotment gardens (Tapach, July 1998, and July 1999).

Section	Method	<i>G. funebrana</i>	
		1998	1999
Single gardens	MD	3.67	-
Gulaschgasse	MD	2.75	6.00
Rosenweg	<i>Trichogramma</i>	0	3.00
Mondscheinweg	granulosis virus (once) and <i>Trichogramma</i>	10	5.3
Average		3.6	4.5

Table 5. Mean number of moths per pheromone trap per week (1999)

Section	Method	<i>C. pomonella</i>	<i>A. orana</i>	<i>G. funebrana</i>
Single gardens	MD	0.13	0.74	0.05
Gulaschgasse	MD	0.1	0.38	0.1
Rosenweg	MD	0.24	1.12	0.48
Mondscheinweg	<i>Trichogramma</i>	3.96	6.43	27.9
Cultivation of stonefruits	untreated	6.65		

Table 6. Estimation of moth infestation on apple in the allotment gardens (Tapach, September 1999).

Section	Method	<i>C. pomonella</i>	<i>A. orana</i>	<i>G. funebrana</i>
Einzelgärten	MD	5.78	0	0
Gulaschgasse	MD	5.95	0.05	0.05
Rosenweg	MD	7.49	0	0
Mondscheinweg	<i>Trichogramma</i>	6.08	0.13	0.064
Tree in nearby meadow	untreated	32.00		

The approximate costs of the different methods are shown in Table 7. The cheapest method is the application of the granulosis virus. When MD was used against all three important moth species, the price is more than 30 DM. The price for the parasitoids is intermediate at about 24 DM.

Discussion

The granulosis virus is directed only against the codling moth. Additional methods have to be applied for the control of the summer fruit tortrix moth and the plum fruit moth. The practical application of the granulosis virus is sometimes difficult. In particular, the correct timing of ap-

plication is a problem. When the treatment was planned for one section of the gardens (Mondscheinweg), rainfall and wind made an application often impossible. There is also a problem with the drift of the pesticide to adjacent plants. Thus granulosis virus application is a task for the individual gardener rather than a task for the club.

Table 7. Costs of the different methods per garden

	MD	<i>Trichogramma dendrolimi</i> , <i>T. cacoeciae</i>	Granulosis Virus
RAK 3+4	15 DM	24 DM	10 DM
RAK 5	15 DM		

MD has been quite successful but the mating disruption of the plum fruit moth has not yet been registered in Germany. Hence, other methods have to be employed against plum fruit moth. For example, the use of pheromone mating disruption against the codling moth could for example be combined with the use of *T. cacoeciae* on plums.

For both MD and egg parasites, the rate of fruit infestation was less than 1 % in 1998 and ca. 6 % to 8 % in 1999. In 1999, the rate was also much higher than normal in commercial orchards. Thus it seems that the pheromone mating disruption can be successful in allotment gardens and is as effective as the use of egg-parasites. However, further investigations are needed with both methods.

Acknowledgements

I thank Les Wardlow, Ashford, Great Britain for linguistic corrections

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